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PROBLEMS OF MANAGEMENT OF THE CLINICAL LABORATORY

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The management of the clinical laboratory is influenced by many factors. Some of them are: the size of the hospital, the type of service that it offers, general or special (tuberculous, obstetrical, orthopedic, mental, etc.), the average length of the patient's stay in the hospital, the size of the town in which the hospital is located, the existence of a flat rate for laboratory work, or of separate charges for all or for some of the tests, the ready availability of laboratory supplies, and the financial status of the hospital. The private laboratory has its own special problems.

Many other important factors could be added. However, there are some problems that all clinical laboratories have in common because their objective is essentially identical: aiding the physician in the recognition of the presence and source of disease, and in the estimation of its progress.

The diagnosis as the central objective, the welfare of the patient as the main motive and the physician who cares for the patient as the intermediary, form the triad that is or ought to be the common feature of all clinical laboratories.

Read before the Fourth Annual Convention of the American Society of Medical Technologists, Excelsior Springs, Mo., May 11-13, 1936.

I cannot, for obvious reasons, speak exhaustively on the subject, and I shall merely touch upon some aspects that strike me at present as more important than others. The selection of the problems that I shall take up was influenced by the nature of my personal experience which is limited to hospital laboratories.

The Technologist

The essence of laboratory work is technic. The technic of clinical laboratory work has certain features that are occasionally overlooked by laboratory directors and frequently ignored by hospital administrators.

The eye above the ocular of the microscope and the brain behind the eye are much more important than the optical system of the microscope, and the eye and the brain will not work efficiently without a certain minimum of essential conditions. Peace, time, and possibility to concentrate—these are essentials. If they are not furnished, even the best technician will carry on work for some time at a terrific cost to health but sooner or later the quality of the work will suffer and so will the patient.

One of the ways to give the technician enough time for his technical work is not to burden him with duties that a typist, an orderly, or a maid can do just as well. I have seen such highly uneconomical arrangements in some laboratories where the technician was unable to do his work as well as he should and could have done, because he was obliged to spend a good portion of the day on washing glassware, plugging test tubes, attending to the sterilizer, scrubbing table tops, etc. I can think of no greater waste than such faulty economy.

I should like to bring this paragraph more than any other to the attention of hospital boards and administrators.

Next, I wish to touch briefly upon a delicate point and I hope what I say will be understood in the same spirit that it is meant.

Efficient laboratory work requires the complete devotion and the full time of the technician. After a technician has acquired the necessary knowledge and training, he has his hands full to keep up with the constant progress in the field of technic. If he forgets that and follows the temptation to enter upon activities for which he is not equipped by training, he goes contrary not only to the main purpose of the clinical laboratory which is the welfare of the patient, but also to his own interests. I refer to the tendency of some technicians to forget that the field of the technologist is technic and that the interpretation of laboratory tests and their

selection for the needs of the individual patient according to his clinical condition is another full time job of a medically trained physician who makes a specialty of clinical pathology. The indication for laboratory tests and the interpretation of results require frequently a bedside consultation and a study of the patient's record —both obviously purely medical functions.

Thanks to the American Medical Association, the American College of Surgeons, the American Society of Clinical Pathologists, there is growing a correct conception of the proper relationship between the patient and his physician, and between the latter and the director of laboratories and the technologist. As I see it, the Society of Medical Technologists has the great mission to hasten the elimination of such abuses by some laboratory technologists. I do not wish to be misunderstood—I am not advocating that the technologist be left in ignorance of the medical aspects of his work. Nothing would be more detrimental. I have too much respect for the intelligence that an able technologist does, and must possess, but an interest in the medical phases of laboratory work does not imply the ability and competence to interpret the results of laboratory examinations in their clinical significance.

In a well run clinical laboratory, the technologist is responsible for his work only to the director of the laboratory. Any criticism or suggestion should come through him. On the other hand, the director must be willing and able to shoulder the responsibility and to act as a buffer. The technologist must not be commandeered by members of the medical or administrative staff in a way that would interfere with his work.

The same professional and ethical obligations to patient and hospital that bind the physician are obligatory for the technologist. The physician being the only intermediary through whom laboratory work is done for the patient, no reports or parts of them should under any circumstances be given out directly to the patients.

The Interne In the Laboratory

There is a great difference of opinions concerning the place of the interne in the laboratory. According to some writers on the subject, the graduate of a medical school receives an adequate training in the technic of the usual laboratory procedures and he can be relied upon to do them as an interne, just as he is entrusted with the writing of clinical histories and with the physical examination of patients. I agree that such internes do exist, but I doubt whether they are the rule. The analogy with the history and with the physical examination cannot be accepted without reservations.

If a mistake is made in them, a correction by the attending physician is readily accomplished. An error in a laboratory test cannot be checked by him with equal ease and competence, and the danger to the patient is obvious.

Depending on the length of interneship, the interne's stay in the laboratory varies from six to twelve weeks. Not all internes are interested in laboratory work, and therefore it is not reasonable to place on them the responsibility for reliable results. The interne's position in the laboratory for the management of which I am responsible is that of a student. He has to follow an outlined curriculum, which provides for his training in the more common tests, particularly the tests that he may have to carry out in his office practice. His work is done under the supervision of my assistant and of the more experienced technologists. Stress is laid upon the technic of drawing of blood from the vein. The training in pathology which includes assisting at autopsies is done under my direction. I am quite satisfied that our scheme fulfills two objectives: (a) the interne gets the best practical training possible in the short time that is available, and (b) the welfare of the patients is protected.

The Unnecessary Tests

In these days when so much is written about the cost of medical care, the proper choice of laboratory tests is a matter of great importance. That holds particularly for hospitals with a flat rate for some or for all laboratory tests. Everybody agrees that some of the so-called routine examinations in such hospitals are more or less superfluous. It has been my experience that no rules or regulations will stop such abuse, but that it will be reduced to the minimum only when the pathologist is called upon more frequently than at present to act as a consultant in questions pertaining to indications for laboratory tests. Then and only then will unnecessary laboratory tests be avoided and what is even more important, all tests that are indicated will be carried out. As a result, once more the interest of the patient will be served best.

Emergency Examinations

A category of examinations that is intimately related to the efficiency and usefulness of the clinical laboratory and to its economical management are the so-called emergency examinations.

A laboratory does not fulfill its obligations if it is not organized to take care promptly and efficiently of emergencies. One can say without exaggeration that the speed with which a laboratory test

is done in an emergency is frequently the most important single factor that helps to save human life. The laboratory staff must be prepared for such emergencies. They require team work and a prearranged schedule of procedures. When emergencies are met promptly and efficiently, the laboratory will earn well deserved recognition by the medical staff. On the other hand, nothing is resented quite so much as the failure of the laboratory to discharge its full duty in an emergency.

It must be appreciated that an emergency examination necessitates a much greater effort and more time on the part of the laboratory staff than the planned routine work. The frequency of emergency examinations must be taken into consideration when the output of a laboratory is evaluated. Another point that must be kept in mind is that there is need for separating true emergencies from what I like to call pseudo-emergencies. The latter are the emergencies that are actuated by the convenience of the attending physician and not by the condition of the patient. Such pseudo-emergencies do not work for economy. The difficulties arising from this abuse can be handled only by the pathologist who is able to meet the clinician on his own ground. The director of the laboratory will frequently gain cooperation of the members of the medical staff by calling their attention to the fact that by ordering unnecessary emergency examinations they impose hardships upon the staff of the laboratory and impede its efficiency. In my experience, such presentations are always rewarded with fullest cooperation.

Equipment

Most of us will agree that the equipment in a laboratory ought to be qualitatively adequate, quantitatively ample, and up-to-date in its efficiency. It is not necessary to have the latest instruments that have just been placed on the market. As a matter of fact, one should approach the latest in laboratory equipment with great caution. Some of it dies a natural death, as do most of the gadgets in the new models of our automobiles. It is advisable to observe a policy of interested watchfulness and to be ready to adopt new instruments only after they have stood the test of time. On the other hand, there is occasionally no greater waste than the use of antiquated and inefficient equipment. Sometimes it is the accuracy of the work that is affected and frequently inefficient equipment is the cause of delays in getting results or of waste of materials.

One should not expect good work from a technologist unless one supplies good working tools.

The laboratory director and the technologist will profit very much from a careful study of and frequent references to the catalogs of laboratory equipment and supplies of the larger commercial houses. I have found such catalogs just as indispensable as the textbooks on laboratory technic.

Records

It is scarcely necessary to discuss in detail the importance of proper records for the laboratory. That is quite generally recognized, and the failure to keep good records is more frequently due to negligence than to ignorance. I feel inclined to say a word about the other extreme that one encounters once in a while: keeping too elaborate and cumbersome records. Such records may become a liability rather than an asset. I am referring particularly to the various indexes and cross indexes, the upkeep of which entails a great deal of effort and time and which are utilized so rarely that in most cases it would be more economical to spend a little more time in searching for the information on the particular occasion when it is actually needed than to keep up the different cross indexes as a matter of routine. I have found it expedient to maintain a complete cross index according to organs and diagnosis, names, and numbers, for the surgical pathological and for the autopsy specimens. The bacteriological reports are entered in an accession book with numbered pages that has an alphabetical index at the beginning. The name of the patient and the page number are entered in the alphabetical index. That gives a rather simple cross index for future references. The reports of all laboratory examinations are copied in a large record book in each department. The original report is placed on the chart of the patient. Copies of reports on the results of examinations of tissues are mailed to the attending physicians. Copies of other reports are mailed only if the work was completed after the patient has left the hospital. Every technologist lists at the end of the day the number of the different examinations that were completed and the clerk prepares from that list, after a proper check, the monthly report, a copy of which is sent to the office of the director of the hospital.

It is not possible in a short space to offer a generally adaptable outline of details of management of the clinical laboratory. They have to be worked out in each institution to meet its particular needs. There is a solution for most problems of management, provided that common sense, professional knowledge and experience combined with adequate facilities are put to work.

SURVEY OF SCHOOLS FOR CLINICAL LABORATORY TECHNICIANS*

The first serious effort made to elevate the standards of education for clinical laboratory technicians was made in 1928, when the American Society of Clinical Pathologists established its Board of Registry. At first, admission to the Registry was based on credentials and recommendations. In 1933 a more accurate system of identifying those qualified for registration was instituted by placing in operation the examination system. At the same time the board made a questionnaire survey of schools for laboratory technicians and set up a minimum standard for approved schools. The first list of schools published under the Board of Registry appeared in 1933.

Since the beginning of the Registry there has existed an active cooperation between the Board of Registry and the Council on Medical Education and Hospitals. Realizing the need for inspection of schools seeking approval, the board in 1933 informally requested the aid of the Council in making such inspections in connection with its regular hospital survey work. Since the Council considered this training as a special type of medical education definitely related to the improvement of hospital standards, it decided to make a comprehensive survey of the situation.

One hundred and ninety-six schools have been visited by members of the Council staff. They are of three general types:

1. *The College or University Course.*—Instruction in these courses is based on regular entrance requirements of the particular college or university and credits are exchangeable with other schools of the same standing. The fourth year is usually given over to instruction and practice training in a hospital laboratory department affiliated with the educational institution. As a rule, on completion of the fourth year, a Bachelor of Science Degree in Medical Technology is conferred. Several schools continue throughout the four years with didactic training incorporating such courses as bacteriology, clinical microscopy, organic chemistry, physiologic chemistry, and physiology, in lieu of a year of practice training in a hospital laboratory.

2. *Hospital Laboratory Departments Offering Courses on the Apprenticeship Basis.*—This group is by far the largest. Students are admitted on one, two, three or four years of college training, including basic sciences or graduation from an accredited nursing school. The work is not highly organized, as the majority of the schools have

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from two to four students enrolled each year. Students attend lectures with nurses or separately. Text assignments, demonstrations and examinations are regularly scheduled.

3. *Commercial Schools.*—The large tuition fees always required by commercial schools constitute the main admission requirement. Students are recruited through extravagant advertising in newspapers and magazines or by a series of follow-up letters, which are often so worded as to imply that employment is secured for graduates at attractive salaries. Since such schools depend on a continuous and expensive campaign of advertising, they are tempted to admit whatever candidates apply regardless of adequate preparation. For the same reason, there is a tendency to admit students whenever they apply. The Council's continuous contact with hospital laboratories and pathologists throughout the country has provided incontrovertible evidence that graduates of commercial schools are not as a class the most desirable.

The survey of schools included twenty-six universities and colleges, 149 hospital laboratory schools, twelve independent laboratories and nine schools of commercial type, operating independently of hospitals or educational institutions. The inspection reports include the following data: organization, teaching staff, clinical facilities, physical equipment, records, entrance requirements, curriculum, library and affiliations. Copies of these reports have been supplied to the Board of Registry for its use in evaluating the training provided by the various schools.

After a careful study of the data gathered in the survey, minimum standards for the approval of schools for clinical laboratory technicians were formulated. It was mutually agreed in conference with members of the Board of Registry that the Council on Medical Education and Hospitals would maintain a list of approved schools for clinical laboratory technicians in operation throughout the United States and would maintain a continuous contact with and inspection of such approved schools.

The essentials were adopted by the Council on May 10, 1936, and after having been approved by the Board of Registry of the American Society of Clinical Pathologists were passed on by the House of Delegates at the Kansas City session, May 11-15, 1936. It will be noted that these essentials do not differ greatly from those formerly adopted by the Board of Registry.

(Continued on Page 205)

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Geographic distribution of schools for clinical laboratory technicians which conform to the standard adopted by the American Medical Association.

Schools for Clinical Laboratory Technicians Conforming to the Standard Adopted by the American Medical Association in 1936

	Name and Location of School	Director	Entrance Requirement	Hospital Bed Capacity	Occupancy	Staff	Duration of Course	Number of Students	Tuition	Certificate Diploma Degree	
	CALIFORNIA										
1	Children's Hospital, Los Angeles	C. M. Hyland, M.D.	Coll. grad.	180	129	4	12 mos.	3	None	None	1
2	Los Angeles County Hospital, Los Angeles	N. G. Evans, M.D.	Coll. grad.	3,266	2,287	12	12 mos.	8	$50	Certificate	2
3	Mount St. Mary's College [a] (St. Vincent's Hospital), Los Angeles	E. M. Butt, M.D.	High sch. grad.	200	118	Dir. and coll. fac.	4 yrs.	..	$600 yr. inc. board	B.S.	3
4	Huntington Memorial Hospital, Pasadena	A. G. Foord, M.D.	2 yrs. coll.	186	94	6	12 mos.	3	None	Certificate	4
5	Mary's Help Hospital, San Francisco	Z. E. Bolin, M.D.	2 yrs. coll.	120	86	3	18 mos.	2	None	None	5
6	University of California Hospital, San Francisco	I. C. Schumacher, M.D.	2 yrs. coll.	264	182	6	16 mos.	4	None	None	6
	COLORADO										
7	Children's Hospital, Denver	E. I. Dobos, M.D.	2 yrs. coll.	250	114	4	12 mos.	1	None	Certificate	7
8	University of Denver, Denver [a 1]	Philip Hillkowitz, M.D.	High sch. grad.	795	490	16	4 yrs.	21	$225 yr.	B.S.	8
	GEORGIA										
9	Emory University [b] (Emory University Hospital), Emory University	Roy R. Kracke, M.D.	B.S.	225	85	9	18 mos.	8	$225 yr.	M.S.	9
	ILLINOIS										
10	Michael Reese Hospital, Chicago	K. M. Howell, M.D.	2 yrs. coll.	560	431	12	12 mos.	12	$100	Certificate	10
11	Mt. Sinai Hospital, Chicago	I. Davidsohn, M.D.	2 yrs. coll.	163	116	7	18 mos.	5	$125	Diploma	11
12	Northwestern University [2] (Passavant Hospital), Chicago	H. L. Alt, M.D.	2 yrs. coll.	300	120	12	12 mos.	8	$50	Certificate	12
13	St. John's Hospital, Springfield	F. W. Light, M.D.	R.N. or 2 yrs. coll.	567	417	4	12 mos.	4	$50	Certificate	13
14	St. Therese's Hospital, Waukegan	E. Pribram, M.D.	2 yrs. coll.	135	56	4	12 mos.	2	$60	Diploma	14
	INDIANA										
15	Indianapolis City Hospital, Indianapolis	H. C. Thornton, M.D.	2 yrs. coll.	538	429	7	12 mos.	1	$50	None	15
16	Methodist Episcopal Hospital, Indianapolis	H. M. Banks, M.D.	2 yrs. coll.	478	330	8	24 mos.	2	None	Certificate	16
17	South Bend Medical Laboratory, [2] South Bend	A. S. Giordano, M.D.	2 yrs. coll.	280	164	4	18 mos.	2	$125 yr.	None	17
	KANSAS										
18	University of Kansas Hospitals, Kansas City	C. J. Leitch, M.D.	B.S.	228	180	6	12 mos.	..	[c]	None	18
19	St. Francis Hospital, Wichita	C. A. Hellwig, M.D.	R.N. or 1 yr. coll.	275	140	5	12 mos.	4	$150	Diploma	19
	KENTUCKY										
20	St. Joseph's Hospital, Lexington	E. S. Maxwell, M.D.	2 yrs. coll.	187	115	6	12 mos.	3	$150	Certificate	20
21	University of Kentucky [a] (Good Samaritan Hospital), Lexington	M. Scherago, D.V.M.	High sch. grad.	200	135	Univ. fac.	4 yrs.	21	[d]	B.S.	21
22	St. Joseph Infirmary, Louisville	H. M. Weeter, M.D.	1 yr. coll.						$150	None	22
23	State Board of Health (Louisville City Hospital), Louisville	L. H. South, M.D.	1 yr. coll.	320	172	4	12 mos.	2			
				528	395	8	12 mos.	10	$300	Diploma	23
	LOUISIANA										
24	Loyola University, [a 2] New Orleans	J. G. Arnold, Jr., Ph.D.	High sch. grad.	348	209	Univ. fac.	4 yrs.	9	$120 yr.	B.S.	24
	MAINE										
25	Central Maine General Hospital, Lewiston	J. Gottlieb, M.D.	A.B. or B.S.	175	141	7	12 mos.	1	None	None	25

	MARYLAND											
26	Mercy Hospital, Baltimore	H. T. Collenberg, M.D.	R.N. or 1 yr. coll.	275	260	18	18 mos.	15	$150	Certificate	26
	MASSACHUSETTS											
27	Simmons College [d] (Faulkner Hospital), Boston	C. M. Hilliard, A.B.	4 yrs. coll.	130	119	4	12 mos.	5	$250	Certificate	27
28	Mercy Hospital, Springfield	J. E. Dwyer, M.D.	1 yr. coll.	330	200	4	12 mos.	5	None	Certificate	28
29	Worcester City Hospital, Worcester	R. H. Goodale, M.D.	R.N. or 1 yr. coll.	360	334	5	12 mos.	6	None	Certificate	29
30	Worcester State Hospital, Worcester	J. M. Looney, M.D.	B.S.	2,240	2,204	5	12 mos.	2	None	Certificate	30
	MICHIGAN											
31	Leila Y. Post Montgomery Hospital, Battle Creek	A. A. Humphrey, M.D.	2 yrs. coll.	158	78	3	12 mos.	2	None	None	31
32	Mercy Hospital, Bay City	W. G. Gamble, Jr., M.D.	2 yrs. coll.	122	75	3	12 mos.	..	$150	Certificate	32
33	Grace Hospital, Detroit	C. I. Owen, M.D.	R.N. or 2 yrs. coll.	483	324	5	12 mos.	6	$150	Diploma	33
34	Henry Ford Hospital [b] (Wayne University), Detroit	F. W. Hartman, M.D.	B.A. or B.S.	572	494	20	18 mos.	8	None	M.S.	34
35	Providence Hospital, Detroit	J. E. Davis, M.D.	2 to 4 yrs. coll.	315	289	7	12 mos.	2	None	Certificate	35
	MINNESOTA											
36	College of St. Scholastica [a] (St. Mary's Hospital), Duluth	G. L. Berdez, M.D.	High sch. grad.	250	167	16	4 yrs.	5	Coll. fee	B.S.	36
37	Swedish Hospital, [e] Minneapolis	C. R. Drake, M.D.	1 yr. coll.	271	151	8	24 mos.	8	$250	Certificate	37
38	University of Minnesota [a b] (University Hospitals), Minneapolis	W. A. O'Brien, M.D.	High sch. grad.	420	315	Univ. fac.	4 yrs.	182	Univ. fee.	B.S.	38
39	Charles T. Miller Hospital, St. Paul	Kano Ikeda, M.D.	1 yr. coll.	199	122	6	12 mos.	6	$100	Certificate	39
	MISSISSIPPI											
40	Vicksburg Sanitarium and Crawford Street Hospital, [f] Vicksburg	L. S. Lippincott, M.D.	1 yr. coll.	75	38	6	24 mos.	6	None	Certificate	40
	MISSOURI											
41	University of Missouri [a] (University Hospitals), Columbia	M. P. Neal, M.D.	[g]	100	60	10	4 yrs.	2	[c]	B.S.	41
42	Kansas City Health Department Laboratory (Kansas City General Hospital), Kansas City	R. W. Kerr, M.D.	1 yr. coll.	430	352	18	18 mos.	15	None	Certificate	42
43	Menorah Hospital, Kansas City	R. Koritschoner, M.D.	2 yrs. coll.	121	76	5	15 mos.	4	None	None	43
44	Research Hospital, Kansas City	F. C. Narr, M.D.	2 yrs. coll.	200	143	6	12 mos.	5	None	None	44
45	St. Joseph Hospital, [c] Kansas City	E. T. Johnson, M.D.	Coll. grad.	225	115	9	24 mos.	6	None	Certificate	45
46	St. Luke's Hospital, [b] Kansas City	F. C. Helwig, M.D.	2 yrs. coll.	205	118	9	16 mos.	7	None	None	46
47	St. Louis University School of Nursing [a] (Firmin Desloge Hospital), St. Louis	W. D. Collier, M.D.	High sch. grad.	223	176	Univ. fac.	4 yrs.	23	$200 yr.	B.S.	47
	NEBRASKA											
48	University of Nebraska Hospital, Omaha	J. P. Tollman, M.D.	2 yrs. coll.	220	168	Univ. fac.	12 mos.	6	None	Certificate	48
	NEW YORK											
49	Kilmer Pathological Laboratory (Binghamton City Hospital), Binghamton	V. W. Bergstrom, M.D.	R.N. or 1 yr. coll.	460	301	8	12 mos.	2	$25	Certificate	49
50	Jewish Hospital, Brooklyn	M. Lederer, M.D.	Coll. grad.	541	377	9	18 mos.	6	None	None	50
51	St. John's Hospital, Brooklyn	T. J. Curphey, M.D.	1 yr. coll.	204	180	4	18 mos.	3	$75	None	51
52	Buffalo City Hospital (University of Buffalo), Buffalo	E. B. Hanan, M.D.	2 yrs. coll.	1,025	967	19	12-24 mos.	16	[i]	None	52
53	St. Joseph's Hospital, Elmira	L. F. Bleyer, M.D.	1 yr. coll.	190	151	3	12 mos.	2	$75	Certificate	53

	Name and Location of School	Director	Entrance Requirement	Hospital Bed Capacity	Occupancy	Staff	Duration of Course	Number of Students	Tuition	Certificate Diploma Degree	
54	Mary Immaculate Hospital, Jamaica, L. I.	Emil Koch, M.D.	2 yrs. coll.	254	231	10	15 mos.	6	None	Diploma	54
55	Ellis Hospital, Schenectady	E. Kellert, M.D.	R.N. or 1 yr. coll.	245	219	7	12 mos.	6	None	None	55
	NORTH CAROLINA										
56	Duke Hospital, Durham	D. T. Smith, M.D.	2 yrs. coll.	406	277	17	15 mos.	12	$50	Certificate	56
	OHIO										
57	City Hospital, Akron	E. L. Saylor, M.D.	B.S. or B.A.	312	213	6	12 mos.	1	None	Certificate	57
58	Institute of Pathology, Western Reserve University (University Hospitals), Cleveland	H. Goldblatt, M.D.	1 yr. coll.	813	462	15	12 mos.	15	None	None	58
59	Mt. Sinai Hospital, Cleveland	B. S. Kline, M.D.	1 yr. coll.	225	14,	7	12 mos.	8	$250	Certificate	59
60	Starling-Loving University Hospital, Columbus	H. L. Reinhart, M.D.	B.S. or B.A.	253	168	5	12 mos.	2	None	None	60
61	White Cross Hospital, Columbus	R. S. Fidler, M.D.	B.S.	246	141	5	12 mos.	2	None	None	61
62	College of Mount St. Joseph-on-the-Ohio [b] (Good Samaritan Hospital, Cincinnati), Mount St. Joseph	R. J. Norris, M.D.	R.N.[j] or B.S.	465	341	4	12 mos.	3	$150	M.S.	62
63	Youngstown Hospital, Youngstown	G. B. Kramer, M.D.	2 yrs. coll.	376	270	6	12 mos.	2	None	None	63
	OKLAHOMA										
64	University Hospital, Oklahoma City	Hugh Jeter, M.D.	Coll. grad.	485	447	8	12 mos.	3	None	None	64
65	Morningside Hospital, Tulsa	H. S. Nauheim, M.D.	1 yr. coll.	225	144	5	12 mos.	1	$150	Certificate	65
	OREGON										
66	Emanuel Hospital, Portland	H. H. Foskett, M.D.	Coll. grad.	230	183	6	12 mos.	2	$150	None	66
67	Good Samaritan Hospital, Portland	C. H. Manlove, M.D.	1 yr. coll.	310	164	6	12 mos.	4	$150	None	67
68	St. Vincent's Hospital, Portland	T. D. Robertson, M.D.	1 yr. coll.	366	304	6	12 mos.	3	None	None	68
69	University of Oregon,[i] Portland	E. E. Osgood, M.D.	1 yr. coll.	375	322	13	12 mos.	4	None	Certificate	69
	PENNSYLVANIA										
70	Abington Memorial Hospital, Abington	John Eiman, M.D.	1 yr. coll.	242	166	9	15 mos.	2	None	None	70
71	St. Luke's Hospital, Bethlehem	H. A. Rothrock, Jr., M.D.	2 yrs. coll.	190	143	4	12 mos.	2	$50	Diploma	71
72	Fitzgerald-Mercy Hospital, Darby	P. J. Kennedy, M.D.	1 yr. coll.	200	69	3	12 mos.	2	$150	Certificate	72
73	Harrisburg Hospital, Harrisburg	G. R. Moffit, M.D.	1 yr. coll.	219	168	8	12 mos.	6	None	None	73
74	Bucknell University [k] (Geo. F. Geisinger Memorial Hospital, Danville), Lewisburg	H. Hunt, M.D.	High sch. grad.	162	121	5	4½ yrs.	2	Univ. fee	B.S.	74
75	Jefferson Medical College Hospital, Philadelphia	B. L. Crawford, M.D.	1 yr. coll.	631	489	12	12 mos.	6	$100	Certificate	75
76	Lankenau Hospital, Philadelphia	S. P. Reimann, M.D.	1 yr. coll.	258	187	7	12 mos	4	$25	Certificate	76
77	Mt. Sinai Hospital, Philadelphia	D. R. Meranze, M.D.	1 yr. coll.	261	187	12	18 mos.	17	$125	Certificate	77
78	St. Agnes Hospital, Philadelphia	J. H. Smith, M.D.	1 yr. coll.	336	230	7	18 mos.	6	$50	Certificate	78
79	St. Joseph's Hospital, Philadelphia	L. A. Soloff, M.D.	1 yr. coll.	150	89	4	12 mos.	4	$100	Certificate	79
80	Temple University [g] (Temple University Hospital), Philadelphia	F. W. Konzelmann, M.D.	High sch. grad.	402	313	14	4 yrs.	30	$600	B.S.	80
	SOUTH CAROLINA										
81	Spartanburg General Hospital, Spartanburg	R. Mosteller, M.D.	2 yrs. coll.	284	173	4	18 mos.	3	None	Diploma	81
	TENNESSEE										
82	Knoxville General Hospital, Knoxville	R. H. Monger, M.D.	1 yr. coll.	350	152	3	12 mos.	3	None	Diploma	82
83	Memphis General Hospital, Memphis	H. Schmeisser, M.D.	B.S. or B.A.	364	377	13	12 mos.	..	None	Certificate	83

	TEXAS										
84	Baylor University Hospital, Dallas	J. M. Hill, M.D.	2 yrs. coll.	300	268	10	12 mos.	f1	$100	Certificate	84
85	St. Paul's Hospital, Dallas	J. L. Goforth, M.D.	R.N. or coll.deg.	270	184	8	12 mos.	2	$100	Certificate	85
86	Robert B. Green Memorial Hospital, San Antonio	R. E. Scott, M.D.	2 yrs. coll.	130	106	4	12 mos.	3	None	Certificate	86
	VIRGINIA										
87	U. S. Marine Hospital, Norfolk	F. C. Smith, M.D.	1 yr. coll.	300	242	8	12 mos.	4	None	Certificate	87
88	College of William and Mary [a] (Stuart Circle Hospital), Richmond	R. C. Beck, M.D.	High sch. grad.	84	56	4	4 yrs.	3	Coll. fee	B.S.	88
89	Medical College of Virginia Hospital Division, Richmond	W. B. Porter, M.D.	2 yrs. coll.	424	355	12	12 mos.	4	$100	Certificate	89
	WASHINGTON										
90	Sacred Heart Hospital, Spokane	M. M. Patton, M.D.	2 yrs. coll.	276	216	3	12 mos.	2	$115	None	90
91	St. Luke's Hospital, Spokane	R. F. E. Stier, M.D.	2 yrs. coll.	173	112	6	12 mos.	3	None	Certificate	91
	WISCONSIN										
92	Madison General Hospital, Madison	L. McGary, M.D.	R.N. or 2 yrs. coll	135	118	2	12 mos.	2	None	Certificate	92
93	St. Mary's Hospital, Madison	S. B. Pessin, M.D.	1 yr. coll.	175	110	7	18 mos.	4	None	Diploma	93
94	Wisconsin General Hospital, Madison	W. D. Stovall, M.D.	2 yrs. coll.	630	611	14	12 mos.	14	$25	Certificate	94
95	St. Joseph's Hospital, Milwaukee	John Grill, M.D.	2 yrs. coll.	325	121	5	12 mos.	2	None	Certificate	95
96	Milwaukee County General Hospital, Wauwatosa	John Grill, M.D.	2 yrs. coll.	1,050	746	8	24 mos.	4	None	Certificate	96

Notes

a. Regular four-year course leading to a B.S. degree.
b. Postgraduate course leading to an M.S. or M.A. degree.
c. Charged on basis of so much per credit hour.
d. Students in state, $94 year; out-of-state students, $120 year.
e. Course includes twelve months x-ray training.
f. Same as for medical students.
g. Course includes six months x-ray training.
h. Course includes four months x-ray training.
i. Ten dollars per credit hour.
j. Plus college chemistry and biology.
k. Four and one-half year course leading to a B.S. degree.

Additional Affiliations

1. Mercy Hospital, Denver—225 beds; 143 occupancy.
   St. Anthony's Hospital, Denver—182 beds; 90 occupancy.
   Greeley Hospital, Greeley—88 beds; 63 occupancy.
   Sanatorium of the Jewish Consumptives' Relief Society, Spivak—300 beds; 194 occupancy.
2. Epworth Hospital, South Bend—155 beds; 91 occupancy.
   St. Joseph Hospital, South Bend—125 beds; 73 occupancy.
3. Hotel Dieu Hospital, New Orleans—230 beds; 139 occupancy.
   Mercy Hospital, New Orleans—118 beds; 70 occupancy.
4. Boston Dispensary, and State Laboratory, Boston.
5. Minneapolis General Hospital, Minneapolis—607 beds; 482 occupancy.
6. Mississippi State Charity Hospital, Vicksburg—100 beds; 72 occupancy.
7. Doernbecher Memorial Hospital for Children, Portland—75 beds; 48 occupancy.
   Multnomah Hospital, Portland—300 beds; 274 occupancy.

ESSENTIALS OF AN ACCEPTABLE SCHOOL FOR CLINICAL LABORATORY TECHNICIANS

I. Organization

1. Acceptable schools for training laboratory technicians may be conducted by general hospitals, colleges or universities. Consideration may be given courses operated by public health laboratories or by pathologists.

2. Responsibility for courses in hospitals should be placed on the hospital administration rather than the laboratory director. In colleges and universities this responsibility is on the controlling board, as for other courses.

3. Resources for continued operation of the school should be insured through regular budgets, gifts or endowments; but not entirely through students' tuition fees. Experience has shown that commercial schools operated for profit frequently do not adhere to proper ethical and educational standards and are, as a rule, not considered acceptable.

4. There must be available transcripts of high school, college work and other credentials. Attendance and grades of students shall be carefully recorded, by means of which an exact knowledge may be obtained regarding each student's work.

II. Faculty

5. The school should have a competent teaching staff. The director must be a graduate in medicine and a pathologist or clinical pathologist of recognized ability. He shall take part in and be responsible for the actual conduct of the training course. He shall be in daily attendance for sufficient time to supervise properly the laboratory work and teaching.

6. In laboratory practice the enrollment shall not exceed one student to each member of the teaching staff. The staff should include not less than one salaried instructor who is a registered technician or eligible for registration, in addition to the laboratory director.

III. Clinical Facilities

7. Each student should receive practice training, adequate in kind and amount, under competent supervision, in a hospital laboratory. The hospital should be registered by and be otherwise acceptable to the Council on Medical Education and Hospitals of the American Medical Association and have a minimum of 2,000 yearly admissions.

8. Adequate space, light and modern equipment shall be provided in the laboratory department. A library containing up-to-date references, texts and scientific periodicals pertaining to clinical laboratory work and pathology should be maintained.

9. Satisfactory record systems shall be provided for all work carried on in the department. Monthly and annual classifications of the work of the department should be prepared.

IV. Curriculum

10. A. Candidates for admission should be able to satisfy one of the following requirements:

1. One year of college work, including chemistry and biology from a recognized college or university. January 1, 1938, this requirement is to be raised to two years of college work.

2. Graduation from a school of nursing recognized by the state board of nurse examiners, and in addition college chemistry.

B. The course of training shall be not less than twelve months in duration and shall include the following divisions:

1. Biochemistry.
2. Hematology.
3. Bacteriology.
4. Parasitology.
5. Histologic technic.
6. Serology.

The instruction shall include:

1. Text assignments.
2. Lectures.
3. Demonstrations.
4. Quizzes.
5. Examinations—written, oral and practical.

V. Ethics

11. Exorbitant fees and commercial advertising shall be considered unethical.

12. Schools conducted for the purpose of substituting students for paid technicians will not be considered for approval.

The Board of Registry, to which full credit must be given for the splendid pioneering work in this field, is made up of six members two of whom are elected annually by the American Society of Clinical Pathologists and serve for a term of three years. The following members comprise the present board: Philip Hillkowitz, M. D., chairman, Denver; Kano Ikeda, M. D., secretary, St. Paul; Israel Davidsohn, M. D., Chicago; H. H. Foskett, M. D., Portland, Ore.; Roy R. Kracke, M. D., Atlanta, Ga., and Asher Yaguda, M. D., Newark, N. J.

According to the Registry, over 3,500 members were enrolled June 1, 1936. This number approximates one-third of the clinical laboratory technicians in the United States and Canada.

Applicants for registration may secure blanks and information from the registrar, Mrs. Anna R. Scott, 234 Metropolitan Building, Denver, Colorado.

HEMOLOGIC OBSERVATIONS ON THE ANEMIAS AND LEUKEMIAS*

I. Myeloid Reaction in Pernicious Anemia

By E. A. SHARP, M.D. and E. M. SCHLEICHER, A.B.

The vagaries of the white blood elements in the anemias and in the leukemias offer one of the most interesting studies in hemology. Much more attention has been directed to the leukocytic patterns characterizing the leukemias, however, than to the behavior of the white blood elements associated with anemia since a differentiation of the abnormal cytologic patterns of the former determine the diagnosis of the entity.

It is unfortunate that the leukocytic patterns found in all hemopoietic disturbances cannot be assigned a diagnostic role comparable in significance to that obtaining in the leukemias. By adopting a systematic method of enumeration and classification, however, definite changes in leukocytic equilibrium occurring in the anemic states manifest a degree of diagnostic and prognostic significance nearly comparable to the implications derived from the accurate and intelligent study of the erythrocytes.

Owing to a developing interest in the Arneth nuclear index and the Schilling hemogram we reported preliminary observations on the leukocytic patterns in the anemic state (1). The scope of the study has been extended to include observations on the cytology of the bone marrow and spleen in addition to the peripheral blood studies. Probable correlations between the leukocytic and erythrocytic patterns in the various clinical phases of the anemias have been the direct result of our early interest in the Arneth and Schilling methods of interpretation. A discussion of the pertinent features of the blood pictures found in pernicious and non-pernicious anemia, in sickle cell and erythroblastic anemia and in the leukemias will be presented in a series of brief communications. The initial observations on the myeloid reaction in pernicious anemia emphasizes the significance of changes in the leukocytes during the various phases of this anemic state.

**From the Anemia Laboratory, Out-Patient Department, Harper Hospital, Detroit, Michigan.*

Method of Study. A "margin-free" blood smear as recommended by Schilling is prepared as follows: A finger-tip is cleaned with gauze wet with ether. The finger-tip is punctured with a lancet (7 mm. x 3 mm.) to a depth of 5 mm. The first drop is wiped off (unless platelet count is to be made), with gauze and the second drop is picked up with the edge of a No. 2 coverslip, 18 mm. size. The coverslip is placed on a micro slide at an angle of 45° about one-half inch from the right end. After the blood has spread along the coverslip edge the spreader slide is pushed rapidly and evenly toward the other end of the slide. Stain by usual methods.

By the use of the "usable area" and "relative average ratio" reported elsewhere (2) by one of us (E. M. S.), enumeration of the percentage relationship of the leukocytic elements by the Schilling index and a morphologic study of both red and white blood elements are made in a uniform manner.

The Right Nuclear Shift. Leukopenia and a neutropenia with a right nuclear shift in the neutrophils constitute a characteristic leukocytic pattern in the untreated stage of severe relapse of pernicious anemia. The right nuclear shift, identified by the presence of the multi-lobed neutrophil of Arneth, containing 7 to 12 nuclear segments, is ascribed to "overmaturity" by Schilling (3). While there is a paucity of discussion about this cell in current literature on hemology, it presents several implications of interest.

Arneth (4), Naegeli (5), Piney (6) and Schilling (7), and others have commented on hypersegmentation of the neutrophil in pernicious anemia. Heck and Watkins (8), in their study of the hypermature neutrophil accredit Briggs with being the first observer in this country to report a similar study. Heck and Watkins (9), found that increased nuclear lobulation was the rule in 50 relapsed cases of Addisonian anemia. Our study of a large series of cases shows a majority incidence, also.

The hypermature neutrophil varies in size as illustrated in figure 2. The diameter ranges from within the normal limits (1½ to 2 times the mean erythrocytic diameter), to 18 u. There is no constant relation, however, between cell size and nuclear segmentation. Occasionally the larger cell shows the greater segmentation, but extreme hypersegmentation is found also in neutrophils of moderate size.

In addition to hypersegmentation of the nucleus of the neutrophil other cells of the myeloid series manifest distinct changes during relapse. These morphologic alterations are largely of a degenerative nature. There is usually marked pyknosis of the nucleus; the

chromatin is dense and seems to be distributed irregularly in the form of large clumps showing protrusions which may or may not be vacuolated. The cytoplasm, in this stage of myelopoiesis, appears cloudy and contains a few ill-defined basophilic granules. In severe degeneration the granules stain poorly (loss of oxydase ferment), and form small and large clumps in a finely vacuolated cytoplasm. In advanced states of degeneration, also, the stab form is extremely fragile; for this reason many ruptured cells are found in a fixed blood preparation.

The number of nuclear segments found in hypermature neutrophils bears no numerical relation to the concentration of neutrophils, nor does the number of neutrophils exhibiting the right nuclear shift seem to predict in any case the degree of anemia. While the greater nuclear segmentation, as shown in figure 2, in our experience has been observed in untreated severely relapsed cases of pernicious anemia, thorough study of the hemogram in cases of comparable severity has failed many times to disclose a neutrophil showing more than 6 to 7 lobes. In all probability the occurrence of polylobulated neutrophils is an interesting myelopoietic phenomenon having no significance other than neutrophilic hypermaturity.

The Left Nuclear Shift. A second interesting leukocytic phenomenon during severe relapse of pernicious anemia is the constant left nuclear shift in the myeloid series. In a sense, it is paradoxical to propose the coexistence of a right and a left shift in the same phase of a myeloid reaction. Particularly, is such a cell scheme bizarre, when it is considered that the total number of neutrophils is appreciably reduced.

Not only does the total number of cell constituents involved in the left nuclear shift during relapse vary from the normal but they show invariably an abnormal numerical balance. Neutropenia has been described as an almost constant finding in uncomplicated severe relapse of Addison's anemia. It might be expected, then, that a reduction in concentration of myelogenous cellular elements might be accomplished without a disturbance of equilibrium between the definitive cells normally present. This course of events would be especially logical in view of the occurrence of a right shift, which connotes myelopoietic deficiency.

The left nuclear myeloid shift, however, occasionally extends to the myelocyte (Figure 1). The juvenil forms are usually present and with a greatly increased number of stabs compromise from 25 to 35 per cent of the entire myeloid series. Schilling considers the increase in number of non-segmented neutrophils as an indication

HEMOGRAM IN COLOR

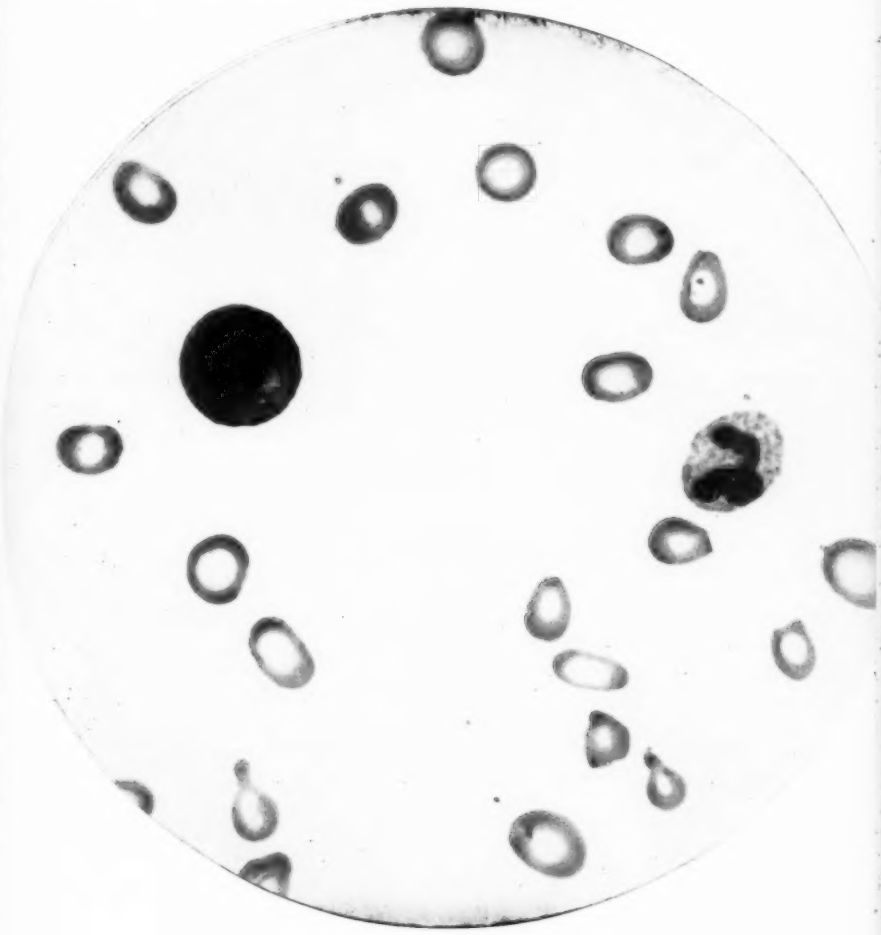

FIGURE 1

Myelocyte appearing in the hemogram during the pretreatment phase of severe relapse of pernicious anemia

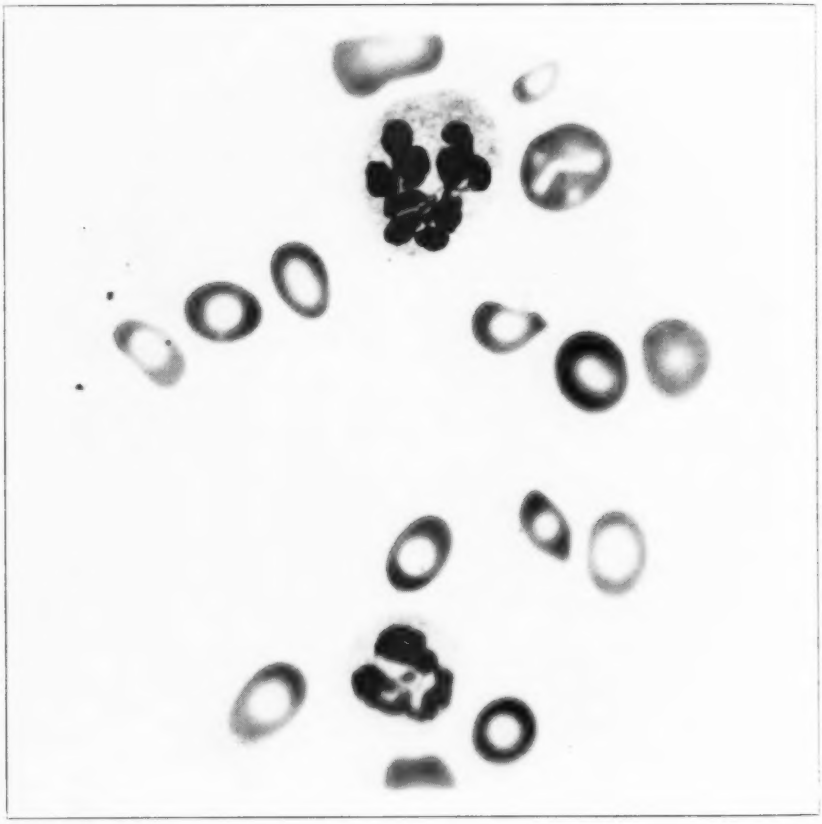

FIGURE 2

Hypersegmented neutrophil in the pretreatment phase of severe relapse of pernicious anemia

of defective neutrophilic leukopoiesis, which results from myelotoxemia. In all probability the shift to the left connotes delayed segmentation and myelocytic under-consumption as well. Obviously the degenerative changes found in the myeloid series, as described above, favor the assumption that noxious factors invade the bone marrow during the stage of untreated severe relapse of Addison's anemia.

The appearance of immature neutrophils in the leukocytic picture in the relapse phase connotes, also, a tendency toward myelopoiesis. For this reason the left shift is said to be initially "regenerative" in pattern. The abnormal number of pre-segmented stab forms considered with the advanced degenerative changes appearing in the cytoplasm of the neutrophil series necessitates a further qualification of the left shift. Inasmuch as a left shift occurs without degenerative changes in certain leukopoietic patterns and is designated as regenerative, it is proper to characterize the typical left shift of the relapsed phase of pernicious anemia as one of a "degenerative-regenerative" character.

Atypical Myeloid Shift. It is recognized, of course, that myelogenic hyperneocytosis is a common response to invading noxa. With few exceptions, among which are influenza, measles, malaria, tuberculosis and typhoid fever, the classical leukocytic response is neutrophilia and hyperleukocytosis.

In the relapse phase of pernicious anemia the leukocytic picture occasionally varies from the typical myeloid reaction described in the previous sections by manifesting a frank neutrophilia. At times even there is an appreciable leukocytosis. This atypical leukocytic pattern of relapse is suggestive of an associated toxemia; therefore, it is of importance hemologically and clinically. From the hemologic standpoint, a toxic process, if not eliminated, will continue to influence the morphologic characteristics of the cells. Obviously, interpretation will be vitiated since the degenerative changes in the neutrophils will be more marked and tend to persist despite adequate treatment of the anemic state. In the hemograms given in table 1 a marked neutrophilia during the pretreatment period occurred coincidently with an extreme left shift. This hyperneocytic phenomenon is particularly remarkable inasmuch as it supervened during a leukopenic phase. The subsequent hemograms made after treatment was instituted, show a persistence of the extreme left myeloid deviation, and in addition, hyperleukocytosis. It is noteworthy that neither the numerical ratio between the neutrophilic series nor their total number changed appreciably.

TABLE I

CASE 1

	R.B.C.	Hb.	Retic.	Leukocytes Total	My.	Juv.	Stab.	Seg.	Eo.	Bas.	Lym.	Mono.
Pretreatment	1.4	40	2.4	4,600	2	2	9	66	0	1	19	1
9th day.....	2.4	48	25.2	4,800	1	5	22	53	2	0	10	2
17th day....	2 8	42	6.7	29,500	0	3	41	52	0	1	3	0
20th day....	2 6	46	8.4	16,700	0	10	26	55	3	1	4	1
25th day....	3.3	48	8.0	10,500	0	10	35	40	3	1	11	0
29th day....	2.8	51	4.7	14,100	0	4	25	52	3	1	13	2
37th day....	3.3	50	13.0	9,400	0	6	30	52	2	1	8	1

CASE 2

Pretreatment	1.7	49	1.4	4,400	0	1	14	34	4	1	42	4
6th day.....	2.5	60	6.2	5,850	0	0	16	34	3	1	44	2
14th day....	3.3	71	4.0	6,400	0	1	14	44	3	0	32	6
21st day....	4.1	80	3.6	6,200	0	0	16	49	6	1	26	2
98th day....	4.7	96	2.5	6,500	0	0	14	33	3	1	46	3
122nd day ..	5.2	103	..	8,000	0	0	14	49	3	1	28	5

Table I. An atypical hemogram in pernicious anemia showing an extreme left myeloid shift, neutrophilia and leukopenia in the pretreatment phase of relapse followed by hyperleukocytosis and persistent left myeloid shift (hyperneocytosis) during early induced remission. This pattern is contrasted with the typical hemograms of Case 2.

Summary

1. Neutropenia and leukopenia are almost constant characteristics of the hemogram during the stage of severe relapse of pernicious anemia.

2. Neutrophilia and sometimes leukocytosis may be found during the relapse phase. When present, either is suggestive of a toxic complication of the anemia.

3. A right nuclear shift in the neutrophil series is the rule in relapse.

4. A left myeloid shift accompanies the right shift in the typical leukocytic pattern of severe relapse of pernicious anemia.

5. The concomitant appearance of hypermature and primitive myeloid cells is a hemopoietic paradox.

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A RAPID ROUTINE METHOD FOR PRODUCING PARAFFIN SECTIONS

By ALMA E. TILLOTSON, M.T.

From the Research Laboratories of the City of Chicago Municipal Tuberculosis Sanitarium

For years those responsible for producing microscopic tissue sections have been striving for less time-consuming methods. There are numerous rapid methods reported in the literature and the consensus seems to be that frozen sections, while invaluable in some cases, are many times inadequate. In most laboratories where a freezing technique is used, the results are checked later with paraffin or celloidin sections, which are kept in permanent files.

A review of the literature for the past ten years reveals that the time required to carry out the various so-called rapid paraffin procedures varies from one hour (1) to three days. Quite naturally anything as flexible as the ordinary paraffin procedure is adapted to the individual technologist and the requirements of his laboratory. The problem is to preserve in the best manner possible, and to impregnate perfectly with paraffin, without too much shrinkage, small pieces of tissue. The many ways in which these ends may be accomplished to the satisfaction of a great number of individuals, is evinced by the variety of methods reported in the literature.

The method here presented is not represented as something entirely new and original. It is an adaptation of procedure to fill the following requirements:

1. Produce sections that are suitable for photomicrography.
2. Produce sections that may be kept permanently.
3. Run thru approximately twenty tissue blocks, from raw specimen to finished slide, in less than six hours, with ample time for other procedures in that interim.

The method here reported has been adopted in our laboratory for routine work for the following reasons:

Read before the Fourth Annual Convention of the American Society of Medical Technologists, Excelsior Springs, Mo., May 11-13, 1936.

1. It produces thin, clear, well-stained sections which are satisfactory for photomicrography.
2. The sections keep indefinitely and are a pleasure to interpret.
3. It is simple, inexpensive, and requires no special equipment.
4. The time required is less than six hours from the raw specimen to the finished slide, for blocks 2 mm. x 1 cm. x 1 cm.

The time may be shortened to one-half or less for smaller fragments of tissue merely by shortening each time interval.

The equipment necessary is available in almost every laboratory:

1. One incubator, which may be kept at a temperature of 57° C., or a water bath at that temperature.
2. Paraffin microtome.
3. Wood mounting blocks (size depending on microtome used).
4. Two small, sharp dissecting needles for handling sections.
5. Small glass jars with screw tops.
6. Wide-mouth, stoppered flasks, 500 cc. to 1 liter in size, for the various solutions.

All the solutions, except the formalin, may be used repeatedly, being changed at intervals consistent with the number of tissues passed through them. The alcohol and carbon tetrachloride may be distilled and reclaimed.

The tissues to be run through may be strung all together on a thread with identification tags between, and immersed in the various solutions, or kept in their own small jars and the solutions poured over them. Scrapings and other fragments, as well as the sediment from centrifuged sputa, may be placed in small gauze bags and treated as individual sections.

Following is the procedure, which is based on the principle that quicker penetration is secured by the aid of gentle heat:

1. Formalin 10%, 30 min. at 57° centigrade.
2. Rinse in water.
3. Alcohol 95%, 30 min. at 57° centigrade.
4. Absolute alcohol, 30 min. at 57° centigrade.
5. Oil of cedar, 30 min. at 57° centigrade.
6. Carbon tetrachloride 30 min. at 57° centigrade.
7. Carbon tetrachloride and paraffin (half and half), 15 to 30 min. at 57° centigrade.
8. 37° melting point paraffin, 45 min. at 57° centigrade.
9. 58° melting point paraffin, 1 hr. at 57° centigrade.
10. Imbed in paper boxes, folded from ordinary paper in the laboratory.
11. Mount on wood blocks.

12. Cut and mount on slides.
13. Dry slides in incubator a few minutes.
14. Xylol, several changes.
15. Absolute alcohol.
16. Cover tissue with thin coating of 1% celloidin.
17. Wash in water.
18. Mayer's hemalum 3 to 4 min.
19. Tap water until blue.
20. Eosin.
21. 95% alcohol.
22. Absolute alcohol.
23. Xylol—mount in balsam.

The technologist should keep in mind that the time periods here specified should be varied directly with the size of the tissue blocks. In other words, for small fragments of tissue the time here stated may be cut to two-thirds or one-half for each solution. This method cannot be used for large pieces of tissue. Blocks larger than 2 mm. x 1 cm. x 1 cm. should be run through with solutions at room temperature or 37°C and changed at longer time intervals.

It may also be noted at this point that the total time involved in the method here presented may be further cut by omitting the steps involving the clearing agent, oil of cedar, and the paraffin-inducing agent, carbon tetrachloride; but that the resulting slides will not come up to the standards set forth previously.

The amount of heat here recommended does not cause undue shrinkage in tissues of the size specified. The time for the whole procedure in the paraffin oven is less than that recommended for orthodox paraffin impregnation alone (2).

It is also to be noted that the passage of the tissue into the final dehydrant is gradual, thereby securing speedier and better results than by plunging it immediately from formalin into absolute alcohol or acetone, as many rapid methods recommend.

Conclusions

This method embodies all the desirable features of a longer embedding process and produces results just as satisfactory. With a little practice and good organization of materials the technologist will find the process consumes very little of his time and that the results will be very satisfactory.

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TECHNIC OF EXAMINING BLOOD FOR PARASITES

By ROSE MATTHAEI, B.A., M.T.

Field Malaria Technologist, Texas State Department of Health
Houston, Texas

The thick smear for blood parasites gives the technologist a better chance to find what he is looking for, although the thin smear also holds an important place, especially in the small clinic or hospital laboratory. I don't know whether the average doctor wants you to do only the stipulated examinations, or whether he is willing, or even anxious for you to add to your list of routine work anything which might aid in diagnosis. If he is of the latter mind, the following can be done with little trouble.

Most of you take two thin smears, as a matter of course, with your routine blood count. The second thin smear is frequently not even stained unless the first one is accidentally destroyed. Instead of making only the two thin films, place two drops of blood on your second slide, one about a quarter of the distance from one end, the other in the center of the slide. Whip the end drop with a circular motion with the corner of a second slide until it is spread to the size of a finger nail. Spread the other drop into a thin smear. Then, instead of staining both slides immediately, put the one with the thick and thin smears away in a dust-free place until the next day, and proceed with your blood count as usual.

In making the differential count, you may find a heavy infection of malaria or relapsing fever spirochaetes. If you do this, you have no further reason to keep your second slide. However, if the blood shows any of the earmarks of being parasitized, and you do not find parasites in your routine careful study, do not waste any more time with the thin smear. You will do well to make an extra careful study of the thick drop after you stain it the following day. If, however, the doctor has requested a search for parasites, make a third slide with the thick drop—stain one thick smear promptly and save the other for checking the following day. This period of processing allows the film to become firmly fixed to the glass slide.

Another addition would be to make thick and thin smears (on the same slide if you like), from the clots of any venous bloods you have for other tests—this has often proved a diagnostic point,

especially in the case of blood from febrile cases where Widals have been requested. Even a patient on whom only a Wasserman has been requested may show a number of parasites—these cases may have those of the clinical symptoms of syphilis which might be very similar to a latent or chronic case of malaria.

Unless malaria is suspected definitely and the examination is requested, these clot films should not be stained for from 15 to 24 hours; if they must be examined promptly, I would advise a second smear for re-check—as it takes time for most of these films to become fixed to the slide.

Back to the thin film—blood parasites may be suspected when there are basophilic stippled cells, also when there are crescent-shaped shadow cells, besides the usual leukopenia. On the other hand, a high leukocyte count does not exclude malaria—we have found parasites in a count as high as 33,000. In the chill period there is nearly always a slight leukocytosis. In suspicious-looking slides we want to keep a close lookout for leukocytes containing melanin or even phagocytized parasites.

In the stained thick drop we often find red cells which even after dehemoglobinization have a finely reticulated appearance. This landmark calls for a careful study—as sooner or later we frequently find a bit of chromatin alone, then a second dot with a shred, or a wing, of cytoplasm attached—or perhaps a characteristic clump of pigment. Melanin or phagocytized parasites may be seen in thick drops as well as in thin smears. Be careful not to confuse a patch of finely granular debris with the characteristically arranged and shaped pigment—the cylindrical brown pigment, bits of which are arranged so that all point in a single direction—or the pigment of the crescent, each found to be a separate and distinct bit upon careful focussing.

All of which brings us to the adage—not only "know thyself" but also "know thy microscope." Use of the oil immersion lens for this work is axiomatic. We find that a maximum amount of light is most satisfactory; however, this is largely a matter of personal opinion, but for best work at least as much light should be used as in a search for bacteria. For best definition—and that is necessary in any except the most obviously positive cases—a 5x or 6x eye piece should be used—at any rate, nothing more than a 7.5x eye piece is satisfactory. A 10x eye piece gives a feathery and indistinct outline to a parasite—and think of giving a positive diagnosis on a feather edged bit of chromatin.

If a single chromatin dot is found—if it really is chromatin—there will be at least one other definite indication of parasites somewhere in the smear. In a case of this kind, examine the film carefully around the edges. Occasionally nothing will be found, even upon long examination, except a single crescent—fortunately this stage of parasite is one which—even in atypical form—is not hard to distinguish. However, unless there is something more definite than merely a dot or two that looks like chromatin, do not call the smear positive—preferably examine another slide at a later date. When in doubt about the color in a chromatin-appearing dot, lower the substage condenser and focus your lens until you can see a halo of light around a bright red dot, which proves at least that you have a spherical red object—chromatin?

Back to the problem of staining—we have found that of the two most commonly used stains, Giemsa's and Wright's, each has its place. It is impractical to use Giemsa's for a quick stain. But if you must use Giemsa's on a thin smear, fix the film first with absolute methyl alcohol. Then, if you have plenty of time, make up your staining solution using 1 part of Giemsa's to 20 (or 40) depending upon the quality of stain—parts of neutral distilled water—and immerse slide in Coplin jar—or stain flat—for 30 or 40 minutes. If you are in a hurry, use more stain and less water —and stain for a shorter time. If you have Wright's stain, you know how to use that to which you are accustomed better than anyone else could tell you.

In staining your thick films, it is better under any circumstances to stain for the longer period of time—making up the Giemsa's stain in the proportion of 1-20 or 1-40 as mentioned above. If, however, you have only Wright's stain, it will be necessary to dehemoglobinize the blood drop in neutral distilled water for about 20 minutes—and then allow the water to drain off and the slide to dry thoroughly before staining with your usual technic.

In any case the thin smear can be used routinely since a heavy malaria infestation which causes acute symptoms will surely show up, and even some heavy infections that are causing vague symptoms only, and the thick smear should be used as a recheck later where no parasites were found in the thin smear. If it is necessary to look over more than 100 fields of a thin smear to find parasites, you are wasting time—depend upon your thick film for that—and unless you get one of those "I just know it's there" feelings about your thick smears, don't spend more than 10 minutes to the slide.

The only other blood parasite we are likely to find in the blood smear—unless we have a patient who has recently arrived from Mexico or Africa—is the spirochaete of relapsing fever—and even that is not common. However, it doesn't take any more time to be on the lookout for these fine spiral-shaped organisms while you are looking for malaria parasites. They are extracellular and are found with the same kind of staining as used for malaria. There are a great many fine shreds of fibrin, etc., which might be mistaken for these spirochaetes, so unless you have a very heavy infection, it is best to confirm your diagnosis with a rat inoculation.

EDITORIALS

THE IDEAL TECHNOLOGIST

In Roget's Thesaurus—that haven of the writer—the word "ideal" is found under the caption "non-existence," or, if you will, "imagination."

It is apparent, therefore, that the formula for the "ideal technologist"—if such a fabulous being could exist, which may be doubted in common with the ideal pathologist—must necessarily vary in accordance with the personal preferences of the one in whose imagination the ideal technologist takes a more or less nebulous form.

My formula may very well conflict with another's but, if I were—as I appear to be—forced to construct one it would probably be along some such lines as these.

First of all, the ideal technician should be honest. Honest in the sense that whatever the job it would be done as thoroughly and as capably as possible; that it would never be skimped nor hustled through; that there would be no hesitancy in repeating it if there was any scintilla of doubt concerning its result, and that it would never be necessary to request such a repetition.

Honest in the sense that, when confronted with something unfamiliar, never attempted before, or in which but little experience has been had, this would be promptly and frankly admitted—for the individual who knows it all has yet to appear before a startled (and, be it said, incredulous) universe.

The ideal technologist would be conspicuous for aptitude and adaptability. Aptitude in that his—or her—progress through the laboratory would be marked by a smooth, quiet, unflurried efficiency, by ease and assurance in the conduct of laboratory procedures and the manipulation of laboratory apparatus.

Adaptability in that he—or she—would appreciate the mutability of laboratory technic and would realize, without specific discussion that the way it had always been done in the previous position was not necessarily the method preferred in the present position. For not infrequently the "best" method of today may become archaic tomorrow.

The ideal technologist would be neat, not only in appearance but in habit. His—or her—worktable would always show an orderly

disorder even under a heavy load of work and, when the day was done, it would appear as if nothing had been done there at all. And so be ready for the demands of the morning to come.

And, with neatness of habit there would be combined a deep and vehement distaste for carelessness, for sloppiness, for lost motion and uncalled for hustle and bustle, and especially for carelessness and ambiguous phraseology in reports. His—or her—reports would always be concise, clear-cut, free from faults of grammar and spelling (especially in the use of technical terms and names), well-phrased, and complete. So complete and clear that there would be no phone inquiries later about the things left out, or unexplained, or so poorly said as to be obscure or even meaningless.

The ideal technologist would be conscious of the fact that laboratory supplies and equipment are expensive and would use them with care and economy. And, when drawing supplies, would note and report the approaching need for replenishment, not waiting until the stock supply was exhausted.

The ideal technologist would have a sense of responsibility and be willing to accept responsibility for errors of omission and commission, for breakage, and for the faults which may be his—or hers; for the ideal technologist is never an "alibi Ike."

The ideal technologist is always willing to help the other fellow, knowing full well that the time will surely come when he may need help in turn.

The ideal technologist develops a habit of concentrating on the job at hand, realizing that faults in technic are often insidious in their inception and that delicate procedures cannot be carried out safely during a running conversation about last week's "date" or the one to come.

The ideal technologist is conscientious, knowing that what could be regarded as "just another blood count" may carry far-reaching consequences to the patient upon whom it is performed.

The ideal technologist, no matter how much may be picked up or garnered from study and experience, will have in mind always the old adage about the dangers of a little knowledge and, consequently will never attempt the interpretation of reports, even when convinced that it could be done.

And the ideal technologist will have enough common sense to know that there will never be an ideal job or an ideal pathologist for whom to work!

—R. A. Kilduffe.

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NEWS AND ANNOUNCEMENTS

REGISTRY OF MEDICAL TECHNOLOGISTS
OF THE
AMERICAN SOCIETY OF CLINICAL PATHOLOGISTS

The fifth edition of the annual Roster of the Certificate Holders of the Registry is now being prepared for publication. A copy will be sent to each registrant. The list this year will contain the names of approximately 3,500 M. T.'s. Corrections in addresses will be appreciated in order to make the list as accurate as possible.

As we go to press one of the largest classes in the history of the Registry is about to take the semi-annual examination under 108 examiners throughout the United States, Canada, Hawaii and the Canal Zone.

NATIONAL

AMERICAN SOCIETY MEDICAL TECHNOLOGISTS
COMMITTEES 1936-37

I. *Committee on State Affiliation*

1. Robert Jenkins, Chairman, Chicago, Illinois.
2. Members of the Advisory Board.
3. Members of the Executive Committee.
4. Sister M. Joan of Arc, Exofficio, Baltimore, Md.

II. *Constitution Committee*

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2. John T. Fitzgerald, Portland, Maine.
3. Robert Jenkins, Chicago, Illinois.
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III. *Exhibits Committee*

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2. Arthur T. Brice, San Francisco, California.
3. Bernice Elliott, Omaha, Nebraska.
4. Myra Effinger, Altoona, Pa.
5. Elizabeth Cramer, Lexington, Ky.

IV. *Research Committee*

1. Phyllis Stanley, Chairman, Newark, N. J.
2. Faith Dravis, Milwaukee, Wis.
3. Anna Mary H. Falck, Lancaster, Pa.
4. Henrietta Lyle, Columbia, Pa.
5. Arthur T. Brice, San Francisco, Calif.

V. *Local Arrangements Committee*

1. Josephine Naame, Chairman, Atlantic City, N. J.
2. Margaret Brown, Montclair, N. J.
3. Violet James, Philadelphia, Pa.

STATE

Missouri

The Missouri Society of Medical Technologists held its semi-annual meeting at Excelsior Springs, Missouri. Officers elected were as follows:

President, Sister M. Bernard Hainen, Booneville; Vice-President, Sister Gertrude Koechner, Booneville; Secretary, Frances K. Criley, Kansas City; Treasurer, Sister Assissi, St. Louis; Executive Committee, Olive W. Stone, Springfield.

New members of the State Society are Augusta Ory Schwein, and Sister M. Hildegard Kimmit.

South Dakota

The South Dakota Society of Medical Technologists held their Second Annual Convention at the State University, Vermillion, South Dakota, on October the 9th and 10th, 1936.

During the first day of the session the technologists enjoyed the privilege of observing the routine procedures carried on in the State Health Laboratory. On the second day a regular program was followed. During the forenoon the business session was held and the following officers were elected:

President—Harry Falconer, Sioux Falls, S. D.; Vice-President—Berniece Iverson, Vermillion, S. D.; Secretary-Treasurer—Sister M. Hermina Locken, Yankton, S. D.

A vacancy on the Board of Counsellors was filled by the election of Arthur Lundquist, Webster, S. D.

During the afternoon the following program was presented:

Diagnosis of Enteric Fever—Dr. Charles A. Hunter, Assistant Director, State Health Laboratory.

Methods for Determining Haemoglobin in Blood—Dr. H. V. Athinson, Professor of Physiology, State University.

Kidney Function Tests—Dr. Edward Shaw, Professor of Biochemistry, State University.

On the evening of October the 10th a banquet was held and the guest speaker was Dr. A. C. Starry, Pathologist at the St. Joseph's Hospital, Sioux City, Iowa.

The place of the next meeting will be at Sioux Falls, South Dakota.

Texas

The Texas Society of Medical Technologists met in annual convention at the Falls Hotel in Marlin, October 9th and 10th.

The meeting was called to order at 10 A. M. by the President, Pauline S. Dimmitt of Sherman. Mayor Hunnicutt and Dr. N. D. Buie made welcoming addresses. Papers were presented by Marian A. Baker, Sr. M. Stella O'Sullivan, and C. C. Hayes. A Round Table discussion and business meeting concluded the morning session. After this a joint luncheon with the Marlin Rotary Club was served.

The afternoon session opened at 2 P. M. with Marian A. Baker presiding. Papers were presented by Dr. Chas. Phillips, C. M. Pitts, Ida Levinson, Dr. Vernal Irons, and C. L. Moses. During the Round Table discussion which followed, the need for standardization of procedures and reporting of results of tests was expressed.

At 8 P. M. a banquet was served, with Dr. H. E. Hipps acting as toastmaster. The banquet was followed by a dance.

Saturday morning Ida Levinson presided. Dr. S. W. Bohls presented two motion pictures. Papers were read by Rose Matthaei and J. E. Storey. Dr. T. J. Crow presented an exhibit. A business session followed during which it was voted to change the name of the Society to the Texas Society of Medical Technologists.

The following officers were elected for the year 1936-37:

President—Ida F. Levinson, Houston; President-Elect—Marian A. Baker, Wichita Falls; Vice-President—Anna Lou Smith, Fort Worth; Secretary—Rose Matthaei, Austin; Treasurer—J. E. Storey, Abilene; Executive Committee—Sr. M. Ursula Coleman, Amarillo; Teresa Brauer, Fort Worth; Dorothy Hall, Dallas; H. A. Bardwell, San Antonio; C. M. Pitts, Austin; Geo. T. Thomas, Beaumont.

Fort Worth was chosen as the next convention city.

BOOK REVIEW

ASTHMA AND HAY FEVER IN THEORY AND PRACTICE. By Arthur F. Coca, M.D., Professor of Immunology, Cornell University Medical College; Clinical Professor in Medicine-elect, New York Post-Graduate Medical School; Editor of the Journal of Immunology; Matthew Walzer, M.D., Instructor in Applied Immunology, Cornell University Medical College; Deputy Attending Physician, Clinic of Applied Immunology, New York Hospital; Chief of Allergy Clinic, Jewish Hospital of Brooklyn; and August A. Thommen, M.D., Lecturer in Medicine, University and Bellevue Hospital Medical College; Director of the Allergy Clinic, Medical College Dispensary, New York University. Charles C. Thomas, Publishers, Springfield, Ill., 1931. Pp. 851. Price $8.50 postpaid.

The subject of allergy and allied conditions is assuming greater importance as time marches on. No branch of clinical medicine is immune from allergic patients. Some clinicians are reluctant to accept it as an explanation of certain phenomena, yet more and more direct evidence points to this as a correct solution of their diagnostic problems. The otorhinolaryngologist has undoubtedly performed many useless as well as beneficial operations where a nasal allergy has been present and unrecognized as such and better methods of differential diagnosis are in order. Help must be given the abdominal surgeon in recognizing his occasional case of abdominal allergy. The already long list of offending agents in industrial dermatoses is steadily increasing. One might almost conclude that nearly any substance could be shown to produce a sensitivity in some one of our population.

This work of Coca, Walzer and Thommen is undoubtedly the most thorough, painstaking and comprehensive work that has yet been published on this subject. Part I, by Coca, deals with hypersensitiveness, anaphylaxis and allergy. Eight of the nine chapters are devoted to a thorough treatise of the subject and the ninth chapter gives methods of preparation of extracts and solutions for use in testing and treatment in human hypersensitiveness. Part II, by Walzer, of 363 pages deals comprehensively with asthma—history, theories, definition, pathology, etiology, clinical course, symptomatology, laboratory findings, classification, differential and specific diagnosis, treatment, methods of testing for hypersensitiveness, and atopens and other excitants. Part III, by Thommen, is devoted to hay fever, 298 pages, with

a thorough treatise of all the offending grasses, trees, plants, weeds, pollens, etc., illustrated with photographs and drawings of many plants and pollens. There is a separate index of atopens and excitants.

The work thoroughly covers every phase of asthma, hay fever and related conditions and contains 2081 references. Although published in 1931 there has been little cause for revision of the work. Our knowledge of the underlying cause for hypersensitive, anaphylactic or allergic manifestations has advanced but little during this time and remains one of the most fascinating medical mysteries yet to be solved. Suffice it to say that it is one of the outstanding books of recent years. It is delightful to read. One may open the book at any page and whether he peruses a paragraph or a chapter he will have been enriched in knowledge of this subject.

ABSTRACTS

IODINE TOLERANCE TEST OF THYROID FUNCTION, E. M. Watson, J.A.M.A., Vol. 107, No. 1, July 4, 1936, page 76.

Detailed technic is given for this tolerance test which may be of diagnostic importance in cases of doubtful thyroid disease.

TWO UNUSUAL TRANSFUSION REACTIONS, P. A. Younge, New England J. Med., April 23, 1936, or J.A.M.A., Vol. 107, No. 1, July 4, 1936.

Of two serious reactions reported, one was due to the dangerous technic in matching blood by using cover slips over plain slides under which there was insufficient room for agglutination in different groups. In the other case thirty minutes proved insufficient time for reading results of the matching, as upon rematching after the transfusion accident, it was found that in forty minutes the donor's cells began to hemolize in the patient's serum.

CULTURE OF HUMAN BONE MARROW: Osgood, Edwin E., and Brownlee, Inez E., J.A.M.A., Vol. 107, No. 2, July 11, 1936.

In this article a simplified technic is given which permits satisfactory growth of marrow and is convenient for growing large numbers of cultures at the same time.

SIMPLE AND INEXPENSIVE METHOD OF MAKING LANTERN SLIDES, Levin, Sam'l. J., J.A.M.A., Vol. 107, No. 2, July 11, 1936.

The author tells how lantern slides may be made with cellophane and carbon paper, or sketches made directly upon the cellophane with india ink, then mounted as ordinary lantern slides. The images produced from these slides are much larger than those from photographic reduction.

LEUKEMIA, Differential Diagnosis of the Leukemic States: Kracke, R. R., and Garver, H., J.A.M.A., 104:697, 1935.

The authors state it is virtually impossible to distinguish between the various types of leukoblasts with ordinary staining methods, or even with vital staining. The most reliable criterian for the diagnosis of any leucemia is a preponderance of immature cells regardless of the total number.

PREGNANCY, Chemical Test for: Mencken, J. G., Deutsche med. Wchnschr. Leipzig, 60: 1837, 1934.

The test originally devised by Vischer and Bowmen was found valuable by Mencken. The reagents: Hydrogen peroxide, phenyl-hydrazine hydrochloride, methyl cyanide, and hydrochlorid acid. Test is performed on the urine and read after twenty-five minutes.

LABORATORY AIDS IN DIAGNOSIS OF ENTERIC INFECTIONS. M. Greenfield: Southwest. Med. 20:385 (Oct.) 1936.

The two most common intestinal infections are typhoid fever and bacillary dysentery.

In the early stages typhoid fever can be most efficiently diagnosed by means of blood culture. Agglutination tests (Widal) also give valuable information. The author favors performing a number of Widals at different periods of the disease, since a rising O agglutinin content of the blood (agglutination with alcohol-killed antigen) is a definite indication of active infection. Stool cultures have little significance except where carried out under carefully controlled conditions both in field, transit, and laboratory.

In the case of bacillary dysentery, the author states that the only true way to determine the type of infection is by identification of the organisms from the stool. She recommends the following solution for preserving stool specimens for shipment to laboratory:

> 30% glycerine in isotonic salt solution, and 0.5% lithium chloride, buffered with potassium and sodium phosphate to hold the pH at 7.5. (This is an attempt to decrease the growth of normal fecal organisms and acidity resulting therefrom, since both Bacterium typhi and Bacterium dysenteriae are both highly sensitive to acid.)

The organism is identified chiefly by means of fermentation reactions which are outlined. Many valuable points are given to aid the laboratory worker to make an accurate diagnosis in as short a time as possible.

A NEW, RAPID, ECONOMICAL TEST FOR PREGNANCY AND CERTAIN GYNECOLOGIC CONDITIONS. Gilfillen and Gregg: Am. J. Obstet. and Gynec. 32:498 (Sept.) 1936.

The test consists of the intradermal injection of two minims of fresh Antuitrin S, the reaction being read one-half hour later. The reaction consists of an area of erythema around the site of injection from 7 to 40 mm. in diameter. A person who is pregnant or who has aborted and retains some live decidual cells does not react; a non pregnant patient does react. (Note: The accuracy of this test has not been confirmed.)

A NEW ANTIGEN AND ITS USE IN THE SERO-DIAGNOSIS OF SYPHILIS. Wadsworth and Brown: J. Immunol. 31:155 (Aug.) 1936.

Preliminary treatment of wet beef-heart tissue with 20% sodium chloride solution at 55°, prior to extraction with alcohol, altered the state of the tissue in a manner advantageous for the subsequent alcohol extraction.

The effect of different amounts of cholesterol and of nature of diluent on the specificity of the beef heart antigen was subjected to intensive study. The amount of cholesterol to be added was highly important since there was a very definite range for optimal sensitization, below and above which the reactivity weakened. It was also found that addition of glucose to the antigen-diluent facilitated the reading of reactions since it gave to the medium a tendency to clear.

THE VALUE OF THE SEDIMENTATION TEST AS A DIAGNOSTIC AID. Hirsh, J. E.: Ann. Int. Med. 10:495 (Oct.) 1936.

The comparison of repeated sedimentation tests is particularly useful for estimating the progress of a disease. The test is now widely employed in gynecological diseases, tuberculosis, rheumatic infections, malignancy, and recently in coronary occlusion. The author discusses its significance in these various conditions.

EXTRACTION OF MALE HORMONE FROM URINE FOR BIOLOGICAL ASSAY. Callow, R. K.: Lancet 2:565 (Sept. 5) 1936.

A method is given for extracting male sex hormone from normal urine. It is said to be the most efficient method yet found. It is based upon a vigorous hydrolysis by acid in order to convert the esterified hormone—in which form it exists largely in urine—into the biologically active form.

Such bioassays are assuming increasing importance in the diagnosis of certain endocrine disorders encountered in the clinic.

PAST DISCOVERIES

von Behring discovered antitoxins in 1889.

Pfeiffer discovered influenza bacillus in 1889.

Koch introduced tuberculin in 1890.